

CLAIMS

1. A cylinder inflow exhaust gas amount calculation system of an internal combustion engine provided with an intake passage, an exhaust passage, an exhaust gas recirculation passage connecting the intake passage and exhaust passage, and an exhaust gas flow rate control valve arranged in the exhaust gas recirculation passage for controlling the flow rate of the exhaust gas flowing in the exhaust gas recirculation passage, and the system calculating an amount of cylinder inflow exhaust gas defined as an amount of exhaust gas flowing into a cylinder, utilizing an amount of passage exhaust gas defined as an amount of exhaust gas passing through the exhaust gas flow rate control valve, wherein

15 an amount of cylinder inflow exhaust gas is calculated considering the dead time corresponding to the time taken until the exhaust gas passing through said exhaust gas flow rate control valve reaches the cylinder and a tracking lag of a change in the amount of cylinder inflow exhaust gas with respect to a change in said amount of passage exhaust gas.

2. A cylinder inflow exhaust gas calculation system as set forth in claim 1, wherein said tracking lag is a first-order lag and a time constant of said first-order lag and said dead time are changed in accordance with an engine speed.

3. A cylinder inflow exhaust gas calculation system as set forth in claim 1, wherein the internal combustion engine is provided with a plurality of cylinders, a ratio of an actual amount of cylinder inflow exhaust gas in each cylinder with respect to said calculated amount of cylinder inflow exhaust gas is found in advance as a distribution constant, and said distribution constant is multiplied with said calculated amount of cylinder inflow exhaust gas to calculate the amount of cylinder inflow exhaust gas in each cylinder.

4. A cylinder inflow exhaust gas calculation

system as set forth in claim 1, wherein the internal combustion engine is provided with a plurality of cylinders, and said tracking lag and dead time are set for each cylinder.

5. A cylinder inflow exhaust gas calculation system as set forth in claim 1, wherein the internal engine is provided with an intake valve with a variable closing timing, and the setting of said tracking lag and the setting of said dead time are changed in accordance
10 with a closing time of the intake valve.

6. A cylinder inflow exhaust gas amount calculation system as set forth in claim 1, wherein a flow rate of gas near an opening of an exhaust gas recirculation passage opening to the intake passage can be changed by one of a change of passage volume from the exhaust gas flow rate control valve to the intake valve in accordance with an engine operating state and a change of a channel sectional area of the intake passage in accordance with the engine operating state, and the
15 setting of the tracking lag and the setting of the dead time are changed in accordance with one of said passage volume and said flow rate of gas.
20

7. A cylinder inflow exhaust gas amount calculation system as set forth in claim 1, wherein a flow rate of gas near an opening of an exhaust gas recirculation passage opening to the intake passage can be changed by one of a change of passage volume from said exhaust gas flow rate control valve to said intake valve in accordance with an engine operating state and a change
25 of a channel sectional area of said intake passage in accordance with the engine operating state, a function equation expressing the amount of passage exhaust gas by a function of the pressure in the intake passage, and a parameter other than the pressure in said intake passage
30 is found and stored in advance, an amount of passage exhaust gas is calculated from the pressure in the intake passage utilizing the function equation, and the
35

parameter other than the pressure in the intake passage is changed in accordance with one of said passage volume and said flow rate of gas.

8. A cylinder inflow exhaust gas amount calculation system of an internal combustion engine provided with an intake passage, an exhaust passage, an exhaust gas recirculation passage connecting the intake passage and exhaust passage, and an exhaust gas flow rate control valve arranged in the exhaust gas recirculation passage for controlling the flow rate of the exhaust gas flowing in the exhaust gas recirculation passage, the system calculating an amount of passage exhaust gas defined as an amount of exhaust gas passing through an exhaust gas flow rate control valve, utilizing a parameter changing said amount of passage exhaust gas and the system calculating an amount of cylinder inflow exhaust gas defined as an amount of exhaust gas flowing into a cylinder, utilizing said calculated amount of passage exhaust gas, wherein

a value of said parameter is read in, a dead time corresponding to the time taken until the exhaust gas passing through said exhaust gas flow rate control valve reaches the cylinder and a tracking lag of a change in the amount of cylinder inflow exhaust gas with respect to a change in said amount of passage exhaust gas are reflected in said read value, and the amount of passage exhaust gas is calculated utilizing the read value in which the dead time and tracking lag are reflected.

9. A cylinder inflow exhaust gas calculation system as set forth in claim 8, wherein said tracking lag is a first-order lag, and a time constant of said first-order lag and said dead time are changed in accordance with an engine speed.

10. A cylinder inflow exhaust gas calculation system as set forth in claim 8, wherein the internal combustion engine is provided with a plurality of

5 cylinders, a ratio of an actual amount of cylinder inflow exhaust gas in each cylinder with respect to said calculated amount of cylinder inflow exhaust gas is found in advance as a distribution constant, and said distribution constant is multiplied with said calculated amount of cylinder inflow exhaust gas to calculate the amount of cylinder inflow exhaust gas in each cylinder.

10 11. A cylinder inflow exhaust gas calculation system as set forth in claim 8, wherein the internal combustion engine is provided with a plurality of cylinders, and said tracking lag and dead time are set for each cylinder.

15 12. A cylinder inflow exhaust gas amount calculation system as set forth in claim 8, wherein the internal engine is provided with an intake valve with a variable closing timing, and the setting of said tracking lag and the setting of said dead time are changed in accordance with a closing time of the intake valve.

20 13. A cylinder inflow exhaust gas amount calculation system as set forth in claim 8, wherein a flow rate of gas near an opening of an exhaust gas recirculation passage opening to the intake passage can be changed by one of a change of passage volume from the exhaust gas flow rate control valve to the intake valve in accordance with an engine operating state and a change of a channel sectional area of the intake passage in accordance with the engine operating state, and the setting of the tracking lag and the setting of the dead time are changed in accordance with one of said passage volume and said flow rate of gas.

25 14. An intake passage inflow exhaust gas amount calculation system of an internal combustion engine provided with an intake passage, an exhaust passage, an exhaust gas recirculation passage connecting the intake passage and exhaust passage, and an exhaust gas flow rate control valve arranged in the exhaust gas recirculation passage for controlling the flow rate of the exhaust gas

5 flowing in the exhaust gas recirculation passage, the system calculating an amount of an intake passage inflow exhaust gas defined as an amount of exhaust gas flowing into the intake passage, utilizing an amount of passage exhaust gas defined as an amount of exhaust gas passing through said exhaust gas flow rate control valve, wherein

10 an intake passage inflow exhaust gas is calculated considering the dead time corresponding to the time taken until the exhaust gas passing through said exhaust gas flow rate control valve reaches the intake passage and a tracking lag of a change in the intake passage inflow exhaust gas with respect to a change in said amount of passage exhaust gas.

15 15. An intake passage inflow exhaust gas calculation system as set forth in claim 14, wherein said tracking lag is a first-order lag, and a time constant of said first-order lag and said dead time are changed in accordance with an engine speed.

20 16. An intake passage inflow exhaust gas calculation system as set forth in claim 14, wherein the internal combustion engine is provided with a plurality of cylinders, said exhaust gas recirculation passage is connected to an intake passage connected to each cylinder, a ratio of an actual amount of intake passage inflow exhaust gas to the intake passage cylinder connected to each cylinder with respect to said calculated amount of cylinder inflow exhaust gas is found in advance as a distribution constant, and said distribution constant is multiplied with said calculated amount of intake passage inflow exhaust gas to calculate the amount of intake passage inflow exhaust gas in the intake passage connected to each cylinder.

25 17. An intake passage inflow exhaust gas calculation system as set forth in claim 14, wherein the internal combustion engine is provided with a plurality of cylinders, and said tracking lag and dead time are set for each cylinder.

18. An intake passage inflow exhaust gas amount calculation system as set forth in claim 14, wherein the internal engine is provided with an intake valve with a variable closing timing, and the setting of said tracking 5 lag and the setting of said dead time are changed in accordance with a closing time of the intake valve.

19. An intake passage inflow exhaust gas amount calculation system as set forth in claim 14, wherein a flow rate of gas near an opening of an exhaust gas 10 recirculation passage opening to the intake passage can be changed by one of a change of passage volume from the exhaust gas flow rate control valve to the intake valve in accordance with an engine operating state and a change of a channel sectional area of the intake passage in 15 accordance with the engine operating state, and the setting of the tracking lag and the setting of the dead time are changed in accordance with one of said passage volume and said flow rate of gas.

20. An intake passage inflow exhaust gas amount calculation system as set forth in claim 14, wherein a flow rate of gas near an opening of an exhaust gas recirculation passage opening to the intake passage can be changed by one of a change of passage volume from said 25 exhaust gas flow rate control valve to said intake valve in accordance with an engine operating state and a change of a channel sectional area of said intake passage in accordance with the engine operating state, a function equation expressing the amount of passage exhaust gas by a function of the pressure in the intake passage, and a 30 parameter other than the pressure in said intake passage is found and stored in advance, an amount of passage exhaust gas is calculated from the pressure in the intake passage utilizing the function equation, and the parameter other than the pressure in the intake passage 35 is changed in accordance with one of said passage volume and said flow rate of gas.

21. An intake passage inflow exhaust gas amount

calculation system of an internal combustion engine
provided with an intake passage, an exhaust passage, an
exhaust gas recirculation passage connecting the intake
passage and exhaust passage, and an exhaust gas flow rate
control valve arranged in the exhaust gas recirculation
5 passage for controlling the flow rate of the exhaust gas
flowing in the exhaust gas recirculation passage, the
system calculating an amount of passage exhaust gas
defined as an amount of exhaust gas passing through an
10 exhaust gas flow rate control valve, utilizing a
parameter changing said amount of passage exhaust gas and
the system calculating an amount of intake exhaust gas
defined as an amount of exhaust gas flowing into the
intake passage, utilizing said calculated amount of
15 passage exhaust gas, wherein

a value of said parameter is read in, a
dead time corresponding to the time taken until the
exhaust gas passing through said exhaust gas flow rate
control valve reaches the cylinder and a tracking lag of
20 a change in the amount of cylinder inflow exhaust gas
with respect to a change in said amount of passage
exhaust gas are reflected in said read value, and the
amount of passage exhaust gas is calculated utilizing the
read value in which the dead time and tracking lag are
25 reflected.

22. An intake passage inflow exhaust gas
calculation system as set forth in claim 21, wherein said
tracking lag is a first-order lag, and a time constant of
said first-order lag and said dead time are changed in
30 accordance with an engine speed.

23. An intake passage inflow exhaust gas
calculation system as set forth in claim 21, wherein the
internal combustion engine is provided with a plurality
of cylinders, said exhaust gas recirculation passage is
35 connected to an intake passage connected to each
cylinder, a ratio of an actual amount of intake passage
inflow exhaust gas to the intake passage connected to

each cylinder with respect to said calculated amount of cylinder inflow exhaust gas is found in advance as a distribution constant, and said distribution constant is multiplied with said calculated amount of intake passage inflow exhaust gas to calculate the amount of intake passage inflow exhaust gas in the intake passage connected to each cylinder.

24. An intake passage inflow exhaust gas calculation system as set forth in claim 21, wherein the internal combustion engine is provided with a plurality of cylinders, and said tracking lag and dead time are set for each cylinder.

25. An intake passage inflow exhaust gas amount calculation system as set forth in claim 21, wherein the internal engine is provided with an intake valve with a variable closing timing, and the setting of said tracking lag and the setting of said dead time are changed in accordance with a closing time of the intake valve.

26. An intake passage inflow exhaust gas amount calculation system as set forth in claim 21, wherein a flow rate of gas near an opening of an exhaust gas recirculation passage opening to the intake passage can be changed by one of a change of passage volume from the exhaust gas flow rate control valve to the intake valve in accordance with an engine operating state and a change of a channel sectional area of the intake passage in accordance with the engine operating state, and the setting of the tracking lag and the setting of the dead time are changed in accordance with one of said passage volume and said flow rate of gas.